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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/708,642	03/17/2004	Chih-Chung Chuang	ADTP0066USA	2641

27765 7590 09/29/2005

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EXAMINER

GEORGE, PATRICIA ANN

ART UNIT PAPER NUMBER

1765

DATE MAILED: 09/29/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/708,642

Applicant(s)

CHUANG ET AL.

Examiner

Patricia A. George

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 March 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on 17 March 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☒ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

Claim 3 is objected to because of the following informality: The claim language is "...wherein oxygen/fluorine...is SF6/O2 having a ratio...700sccm/300sccm." which is inconsistent when referencing materials. The examiner suggests the phrase "oxygen/fluorine" be changed to --*fluorine/oxygen*--. Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Where applicant acts as his or her own lexicographer to specifically define a term of a claim contrary to its ordinary meaning, the written description must clearly redefine the claim term and set forth the uncommon definition so as to put one reasonably skilled in the art on notice that the applicant intended to so redefine that claim term. *Process Control Corp. v. HydReclaim Corp.*, 190 F.3d 1350, 1357, 52 USPQ2d 1029, 1033 (Fed. Cir. 1999). The term "hard mask" in claim 1 is used by the claim to mean "photoresist", while the accepted meaning is "soft mask." The term is indefinite because the specification does not clearly redefine the term.

Claim 1, and all claims directly or indirectly dependent on claim 1, are rejected because the phrase "slightly oblique" renders the claim indefinite and is unclear. The term "slightly" is considered to be a relative term of degree and the specification provides no definition thus the examiner interprets the claim phrase "slightly oblique" to mean --*oblique*--.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 6, 13, 14, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamagishi et al. (USPN 6809790) in view of Wilson et al. (Handbook of Multilevel Metallization for Integrated Circuits – Materials, Technology, and Applications; William Andrews Publishing/Noyes; 1993; ISBN 0-8155-1340-2)

Yamagishi et al. discloses the method for producing the a liquid crystal display device (fig. 11) including the matrix substrate (fig. 2E) it uses. Yamagishi discloses depositing a molybdenum-containing metal layer (col.9, l.41) on a glass substrate (col.16, l.7) . Yamagishi discloses forming a patterned photo resist (col.8, l.23-25), and defining a gate (fig.1A, p.304) and signal line (col.14, l.58) array (col.5, l.1) pattern.

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Yamagishi discloses using a patterned photo resist as a mask (col.8, l.43), etching (col. col.8, l.9) molybdenum-containing metal layer to form said gate (fig.1, p.304) and signal line (col.14, l.58) array pattern (col.5, l.1). Yamagishi discloses said etching ((col. 28, l. 4) of a metal layer (col.27, l.64), containing molybdenum (col.12, l.27), uses a gas mixture (col. 28, l. 4).

Yamagishi also discloses a round tapered structure of the root portions of the insulating films (col.29, l.28-29), but fails to directly disclose metal lines having oblique sidewalls.

Wilson et al. teaches metal lines having tapered (written on "oblique") sidewalls. (See section: Tapered Etching; p.149, l.7-10.)

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the teachings of Yamagishi's method for producing a liquid crystal display device by including tapered metal lines (i.e. oblique lines) because Wilson teaches tapered metal lines are a technique that will achieve good step coverage. (See section: Tapered Etching; p.149, l.5-6.)

As for claims 6 and 19, Yamagishi discloses a multiple metal layers including: Aluminum electrodes (col.8, l.34-36), Aluminum alloy layers (col.9, l.3-4), a shielding layer (fig. 1A: 350-Ti, 105-TiN, 106-W), and a base layer (col.9, l.11-12). Yamagishi discloses use of high melting point metals (col.9, l.34) such as molybdenum (col.9, l.41) when aluminum is used as an electrode. Yamagishi also discloses use of molybdenum as a shielding layer for covering the display region (fig.7, p. 307).

As for claim 13, Yamagishi discloses a glass substrate (col.16, l.7). Yamagishi discloses using patterned photo resist as a mask (col.8, l.23-24, and l.42). Yamagishi discloses forming a gate (fig.39E, p.204) and aluminum lines (fig. 39E, p.209) pattern on molybdenum (col.9, l.41), a material having a higher melting point (col.9, l.34) than that of said electro-conductive members is placed at the base of said projecting region (col.5, l.5-7). Yamagishi discloses dry etching (col.8, l.43) a Ti metal layer (col.8, l.40) by patterned photo resist (col.8., l.42). Yamagishi discloses molybdenum (col.9, l.41) is of the same metal group as Ti (col.9, l.39).

As for claim 14, see discussion on tapered sidewalls above.

Claim Rejections - 35 USC § 103

Claims 2, 7, 15, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamagishi and Wilson, as applied to claims 1, 6, 13, 14, and 19 above, in further view of Kim et al. (USAN 10/327,084) and Przybysz et al. (USPN 4,904,980).

The combined teachings of Yamagishi and Wilson fail to disclose an over etching when etching the metal layer, as in claims 2 and 15. Yamagishi and Wilson fail to disclose the same materials used for the dual-metal layer, as in claims 7 and 20.

Kim et al. teaches a fabrication method for forming an array substrate of a liquid crystal display. Kim teaches the over etching of Mo is known and common in prior art (p.0027, l. 4), as in claims 2 and 15. Kim teaches use of a three metal layer, Cr/AlNd/Mo, for source, drain, and data line electrodes (fig. 8. 141, 143, and 145), as in

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claims 7 and 20. The three layer material selected by Kim is not the same as the dual layer claimed in the instant invention, however, some of the metals and alloys thereof are the same as the claimed metals and the disclosed invention would have the same capability as the limitation claimed.

Przybysz et al. teaches the overetch is commonly employed during the etching of Mo because it is necessary, to allow time for the pattern to become fully defined (Description of the preferred embodiments -paragraph 4).

Since the teachings of Kims three layer metals have the same capability as the claimed dual layer metals, it would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the methods of producing liquid crystal displays, as taught in the combined teachings of Yamagishi and Wilson, by selecting Cr/AlNd/Mo as the source drain and data line electrodes, because Kim illustrates Cr/AlNd/Mo are useful for source, drain, and data line electrodes in an array substrate of a liquid crystal display.

It would also have been obvious to one of ordinary skill in the art at the time of invention was made, to combine the overetch, as taught by Kim in prior art, with the liquid crystal display invention, of Yamagishi and Wilson, because Kim which indicates it is a known and commonly used to to allow the pattern to become fully defined.

Claim Rejections - 35 USC § 103

Claims 3, 9, 10, 11, 12, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamagishi and Wilson, as applied to claims 1, 6, 13, 14, and 19 above, in further view of Hori et al. (USPN 5445710).

The combined teachings of Yamagishi and Wilson do not disclose the specific gas mixtures or ratio of claims 3, 9, 10-12, and 16.

Hori et al. teaches dry etching method of a substrate containing carbon; patterning the film through a resist mask; using a gas plasma; with fluorine and O₂ gases. Hori teaches an embodiment that includes chlorine, as well as fluorine and O₂ gases. Hori teaches plasma etch with the presence of carbon atoms from a film. Hori also teaches etch gases containing fluorine atoms and oxygen atoms are mixed at an atomic ratio of fluorine to oxygen to 198:1 to 1:2. Hori's ratio range encompasses the range claimed in the instant invention. In example 3, Hori used a variety of gases with oxygen (O₂-col.16, l.66), including: chlorine (Cl₂-col.17, l.3), fluorine (SF₆-col.17, l.3), and chlorine (Cl₂) and fluorine (SF₆) combined (col. l.18).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the LCD manufacturing method, disclosed by Yamagishi and Wilson, by modifying the etchant gas mixtures and ratios, as taught by Hori, because Hori teaches combinations that improve the results of dry etching (col.1, l.18).

Claim Rejections - 35 USC § 103

Claims 4, and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamagishi and Wilson, as applied to claims 1, 6, 13, 14, and 19 above, in further view of Cheung et al. (USPN 5354417).

The combined teachings of Yamagishi and Wilson fail to disclose the etching of said molybdenum-containing metal layer is executed under a process pressure higher than 25 mTorr, as in claims 4 and 17.

Cheung teaches use of SF₆, HBr (col. 2, l.63), and an oxygen containing gas (col.2, l.64) for an improved selective etching of a substrate (col.2, l.60) having molybdenum-containing layer (col.2, l.61). Cheung teaches the combination of Cl₂ and O₂ is typical (col.1, l.21-22) but they cause problems including "reentrant" profiles (col.1, l.29-30). Cheung teaches the process pressure at a range of 1 mTorr to 300 mTorr when etching a molybdenum-containing metal layer, which encompasses the range of higher than 25 mTorr, in claims 4 and 17.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to include the improvement of an increase etch rate using an increase the process pressure when etching a molybdenum-containing metal layer, as taught by Hori, with the method for producing a liquid crystal display device that includes a matrix substrate, disclosed by Yamagishi and Wilson, because it is a well known in the art that a high process pressure improves the process by using the abundance of the reactive species available, with the results of an increased the etch rate.

Claim Rejections - 35 USC § 103

Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yamagishi and Wilson, as applied to claims 1, 6, 13, 14, and 19 above, in further view of Celii et al. (USPA 10/282621).

The combined teachings of Yamagishi and Wilson are silent to the dry etch being controlled by a source power, a bias power, process pressure, oxygen flow rate and flow rate of fluorine containing gas, as in claim 5.

Celii et al. teaches an exemplary approach to plasma etching that is bases on Cl₂ and a fluorine gas, with an oxidizer such as O₂, where he controls the process temperature (para.128, l.7). Celii teaches controlling the process pressure (para. 108, l.8), the source power (para.108, l.10) , and bias power para.108, l. 10-11), as in claim 5. Celii also teaches controlling gas flow rates (see pg. 9, tables 3-5) as in claim 5.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to include that dry etch is controlled by source power, a bias power, process pressure, oxygen flow rate and flow rate of fluorine containing gas, as taught by Celii, with the method for producing a liquid crystal display device that includes a matrix substrate, disclosed by Yamagishi and Wilson, because Celii teaches alterations and modifications of various aspects will occur to others skilled in the art (para. 176, l.2-3).

Claim Rejections - 35 USC § 103

Claims 8 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamagishi and Wilson, as applied to claims 1, 6, 13, 14, and 19 above, in further view of Nagata et al. (JP405067590A).

The combined teachings of Yamagishi and Wilson fail to disclose the etching of the molybdenum-containing metal layer is detected by a detection method which will detect a wavelength of about 704 nm, as in claims 8 and 18.

Nagata et al. teaches the etching of a film that has a fluorocarbon with a peak of light emission in of about 700nm (ab.), which is very different than the ordinary resist wavelength of 480nm. Nagata teaches the use of a second material to conduct the etching and when the fluorocarbon film is exposed, an intensity of 704nm (ab.) is detected.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to include the end point detection method of Nagata, in an etch used to produce a liquid crystal display device, as disclosed by Yamagishi and Wilson, because Nagata teaches even when a stepped area exists and the etch rate is not uniform, the end point can be easily and accurately be detected.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Patricia A. George whose telephone number is (571)272-5955. The examiner can normally be reached on weekdays between 7:00am and 4:30pm.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571)272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Patricia A George
Examiner
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SUPERVISORY PATENT EXAMINER
Nadine